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HUMAN RESOURCES

TIME-SHARING ABILITY AS A PREDICTOR OF FLIGHT TRAINING PERFORMANCE

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Modern-day pilots must perform a variety of activities concurrently. In addition to flying the aircraft, they must monitor the communications channels and instrument panel and also navigate. As a result, the ability to allocate attention to different tasks effectively or "time share" is crucial for a safe, well-executed flight.

A compensatory tracking and signal detection dual-task was administered to 1,130 United States Air Force pilot training candidates prior to entry into Undergraduate Pilot Training (UPT). Tracking performance was extremely reliable. Although performance on this task was not predictive of successful completion of UPT, it was related significantly to a post-UPT advanced training recommendation. This task may be useful when it is desirable to place pilot candidates into specialized training tracks at an early point in training. Keywords:

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This publication is primarily a working paper. It is published solely to document work performed.

SUMMARY

Modern-day pilots of military aircraft often must perform several tasks concurrently to ensure a safe, well-executed flight. A compensatory tracking and signal detection dual-task was administered to 1,130 United States Air Force pilot training candidates prior to their entrance into Undergraduate Pilot Training (UPT). Results indicated that the task was extremely reliable. Performance on this task was not predicitive of successful completion of UPT but was related significantly to a post-UPT advanced training recommendation. This task may be useful when it is desirable to place pilot candiates into specialized training tracks at an early point in training.

PREFACE

This work was completed under Work Unit 77191845 in support of a Request for Personnel Research (RPR-78-11, Selection for Pilot Training) submitted by training program managers. This paper is intended to serve as an interim report regarding one of the subtests from the Basic Attributes Tests battery.

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I. INTRODUCTION

Quite often, in both military and industrial settings, human operators are required to monitor and control several tasks concurrently. In addition to flying the aircraft, modern-day pilots must monitor the communications channels and instrument panel and also navigate. The number of tasks that need to be performed concurrently increases dramatically in high-performance military aircraft as a result of the speed of the aircraft and the responsibility for weapon system operations. The importance of a "time-sharing" ability for pilots was illustrated in a study by the National Research Council (1982), which showed that in a current fighter (McDonnell Douglas AV-8B Vertical/Short Takeoff and Landing [V/STOL] light attack aircraft) during a typical air-to-ground mission, up to six activities and systems were attended to concurrently by the pilot. In the extreme, the ability to successfully perform several activities concurrently can determine the difference between a well-executed mission and a fatal accident.

Although there is significant agreement that the ability to time-share is crucial to flying performance (Braune & Wickens, 1985; Damos, 1978; Gabriel & Burrows, 1968; Gopher & Kahneman, 1971; Roscoe & Kraus, 1973; Walker & Walker, 1979), the evidence regarding the measurement of individual differences in time-sharing ability is not conclusive (Ackerman, Schneider, & Wickens, 1984).

Ackerman et al. (1984) contended that the inconsistency of results among studies of time-sharing ability can be traced to methodological flaws in the experimental designs and the lack of a clear theoretical framework defining the critical aspects of time-sharing ability. The three primary sources of methodological problems they cited include the selection of the experimental tasks, control of practice effects for both single- and dual-task performance, and the reliability of the tasks themselves. For instance, the nature of dual-task performance may be quite different depending on the types of resources that are required to perform the tasks (visual, auditory, psychomotor, or some combination of these). These methodological/theoretical problems can be attributed to the overly simplistic view that time-sharing ability can be studied by combining any two or more tasks without considering the resources required for their joint performance.

Wickens and Benel (1982) reviewed several studies on skill learning and individual differences, in an attempt to identify those components which are most critical in determining the level of time-sharing performance. They identified four sources of variance in performance on dual-tasks: (a) single-task practice effects or automation, (b) availability of processing resources, (c) physical structural separation of processing resources, and (d) improved allocation of processing resources.

The above issues formed the basis for an examination of the reliability and validity of a time-sharing task that is part of the Basic Attributes Tests (BAT), an experimental test battery that is designed to improve the selection and classification of United States Air Force (USAF) pilot and navigator trainees. The BAT Time-Sharing Task was evaluated in terms of its ability to predict flight training performance during Undergraduate Pilot Training (UPT). Generally, pilot candidates who perform better on both the single- and dual-task portions of the BAT Time-Sharing Task were expected to perform better during flight training.

In addition to its concern with training attrition, the USAF is interested in classifying pilots for advanced training as early as possible. Currently, student pilots are recommended for one of two types of follow-on training at the end of UPT, which currently involves about 175 hours of flying time. On the basis of an evaluation by an Advanced Training Recommendation Board

(ATRB), graduating pilots go on for operational training in either a Fighter-Attack-Reconnaissance (FAR) aircraft or a Tanker-Transport-Bomber (TTB) aircraft. In general, the students who perform best during UPT are selected for fast-jet training (i.e., FAR). Thus, it was expected that the FAR-recommended pilot candidates would perform better on the Time-Sharing Task than would the TTB-recommended pilots. The demonstration of such a relationship would be useful to the USAF in that the classification procedure could take place earlier in training, resulting in more efficient and cost-effective training at the entry level.

II. METHOD

Subjects

The subjects in the present effort were 1,130 USAF officer candidates targeted for UPT. They were tested on the Time-Sharing Task while attending Officer Training School prior to their entry into UPT. Pilot training performance measures were available for only a portion of the subjects as many of these individuals had not yet completed UPT.

Procedure

The Time-Sharing Task was included in a computer-administered test battery that consisted of 14 tests and lasted about 3 1/2 hours (see Carretta, 1987, for a more complete description of the BAT). After a test administrator initialized the system, the test session was self-paced by the subject. The test session included scheduled breaks between tests to avoid problems with mental and physical fatigue.

The Time-Sharing Task was designed to assess a variety of psychological factors including high-order tracking ability and learning rate, as well as time-sharing ability as a function of differential task load.

In this task, the subject was required to learn a compensatory tracking task during a series of 10 60-second "practice" trials which were followed by combinations of dual-task conditions. To perform this task, the subject had to anticipate the computer-driven movement of a marker ("gunsight") on a screen and operate a control stick to counteract that movement in order to keep the marker aligned with a fixed central point ("target aircraft"). The difficulty of the task to be performed could be controlled by the test administrator, and task difficulty was set at an arbitrary value of 100 at the beginning of trials 1, 11, 14, and 16. This level was chosen because it represented a relatively easy starting level for the tracking task. Task difficulty was adjusted throughout the task depending on the subject's performance on the task. The adjustments were made to keep the tracking error constant by increasing the difficulty as the subject's performance improved. The control dynamics were a combination of rate and acceleration components. The "disturbance" factor, which caused the target "drift" to vary, was a quasi-random summed sinusoidal forcing function.

After the 10 "tracking-only" trials, the subject was required to track while canceling digits that appeared at random intervals and locations on the screen (either two or eight potential digits and responses). The digits were canceled when the subject pressed the corresponding button on a data entry keypad. A "cross-adaptive" logic forced the subjects to respond to digits within a specified period of time after the digits' appearance. (Failure to respond within 4 seconds resulted in the disappearance of the gunsight until a response was made.) These "dual-task" trials occurred in two 3-minute blocks. The information processing load gradually increased during these trials. The task ended with a final 3-minute block of tracking-only trials.

The effects of the secondary task loads were reflected in the pattern of level of difficulty changes caused by the adaptive logic that held tracking error constant. The primary measure of interest in this task was the level of difficulty at which the subject could perform consistently. Including breaks, this task took about 30 minutes.

UPT Performance Criteria

UPT final outcome was scored as a dichotomous variable, with pass = 1 and fail = 0. Pilot candidates who passed UPT received a recommendation from the ATRB for a post-UPT assignment to either a TTB aircraft or a FAR aircraft (TTB = 0 and FAR = 1). Final outcome and ATRB recommendation were determined, in part, by a subject's performance on six check flights during UPT. A check flight involved an in-flight performance evaluation by an Instructor Pilot. The first three check flights took place in a T-37, a low-performance jet trainer, whereas the later three took place in a T-38, a high-performance supersonic jet trainer. The T-37 check flights included: Mid-Phase Contact, a subject's first check flight; Contact, in which the subject's ability to perform maneuvers and aerobatics by visual cues outside the plane was evaluated; and Instrument, in which the subject was required to perform maneuvers by reference to the display on the cockpit instrument panel. The T-38 check flights, in addition to Contact and Instrument, included an evaluation of the subject's ability to fly in formation with other aircraft. Each subject received a check flight grade (1-unsatisfactory, 2-fair, 3-good, or 4-excellent) and a percentage score (based on performance on certain maneuvers during the flight) for each check flight that was completed during training. The check flight percentage scores are not linear transformations of the four-point check flight grades. The check flight grade reflects the Instructor Pilot's evaluation of a student compared to all other pilot candidates at the same point in training. In contrast, the percentage grade is a weighted average of the maneuver grades from a check flight. The number of subjects who had scores on the Time-Sharing Task and performance measures is indicated in Table 1.

Table 1. Number of Subjects Per Measure

Measure	N
Time-Sharing Task	1,130
UPT (pass/fail)	212
ATRB (TTB/FAR)	158
Check Flight Scores	46

III. RESULTS AND DISCUSSION

Descriptive Measures

As previously noted, the task difficulty level was set at 100 at the beginning of trials 1, 11, 14, and 16. Tracking error was measured every 6 seconds, and the difficulty level was adjusted accordingly (made easier or more difficult depending on the subject's performance). As can be seen in Table 2 and Figure 1, average difficulty level improved during each section of the task. Very few subjects were unable to perform at or above the initial difficulty level of 100 (less than 1%). The greatest improvements in tracking performance occurred during the first 2 minutes of each section.

An analysis of variance indicated that tracking performance was affected significantly by the presence of the side task ($F[2,2258] = 986$, $p < .0001$). Tracking performance was significantly better when there was no secondary task (average for trials 17 through 19 [no side task] = 277, average for trials 11 through 16 [side task 1 and 2] = 242; $F[1,2258] = 2,637$, $p < .0001$). Also,

average response time on the secondary task was significantly lower when there were only two potential signals as opposed to eight (average response time for trials 11 through 13 = 1,027 ms., average for trials 14 through 16 = 1,488 ms.; $F[1,1129] = 2,959$, $p < .0001$). Although these differences were statistically significant, the actual effects were relatively small. A summary of these analyses is provided in Table 3.

Table 2. Time-Sharing: Difficulty Level and Response Time by Trial

Trial	Task	Difficulty level Mean	Difficulty level SD	Response time (ms.) Mean	Response time (ms.) SD
1	Tracking only	154	44		
2		259	92		
3		298	83		
4		314	85		
5		315	77		
6		322	76		
7		328	77		
8		334	77		
9		340	75		
10		346	77		
11	with side task 1	150	17	1,106	374
12		269	55	1,012	338
13		325	68	965	315
14	with side task 2	152	16	1,398	370
15		250	52	1,540	379
16		303	67	1,526	378
17	Tracking only	163	15		
18		308	57		
19		361	70		

Note. N = 1,130.

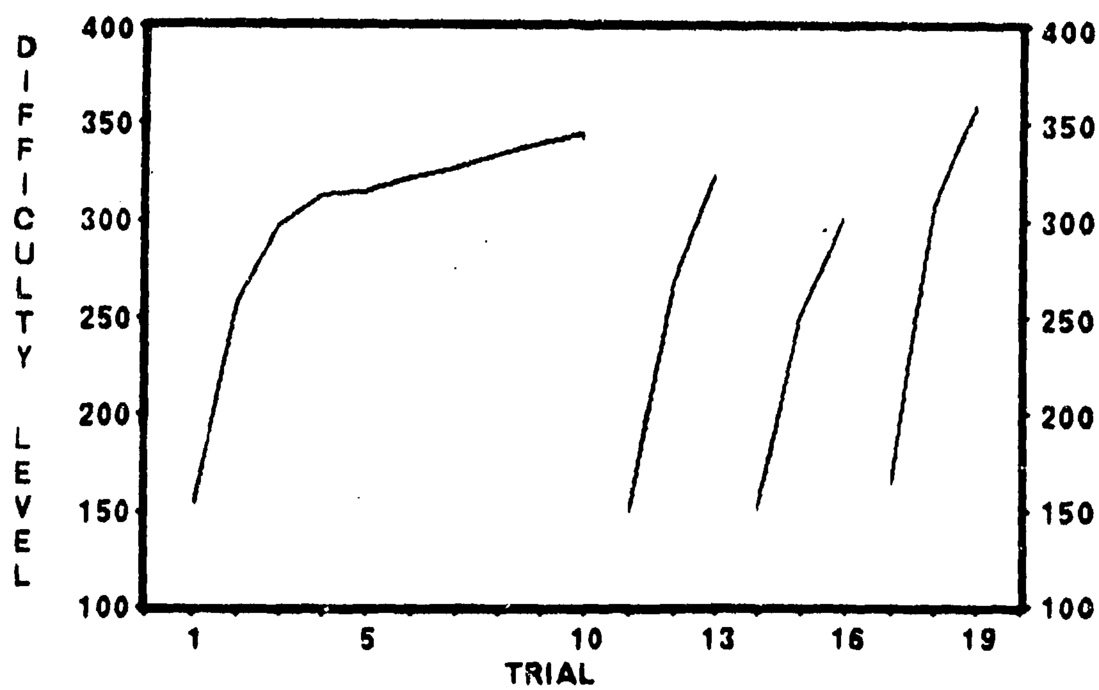

Figure 1. Time-Sharing: Difficulty Level by Trial.

Table 3. Time-Sharing: Summary of Analyses of Variance

Source of Variance	Sum of Squares	DF	Mean Square	F
Difficulty Level				
Between Subjects	5,121,985	1,129	4,537	
Within Subjects	2,310,175	2,260	1,022	
Task	1,077,203	2	538,601	986*
Residual	1,232,972	2,258	546	
Response Time on Secondary Task				
Between Subjects	126,321,845	1,129	111,888	
Within Subjects	171,124,987	1,130	151,438	
Task	123,868,487	1	123,868,487	2,959*
Residual	47,256,499	1,129	41,857	

*$p < .05$.

Tracking performance was extremely reliable. Cronbach's alpha was equal to .995 when difficulty level scores measured each 6 seconds were used (190 scores) and did not decrease significantly when average difficulty level per 1-minute trial was used (19 means, alpha = .956).

In terms of Wickens and Benel's (1982) taxonomy of critical components that determine the level of time-sharing performance, it appeared that performance on the primary task (tracking) became automated for most subjects after only 4 or 5 minutes of practice. Although tracking performance was significantly lower during the dual-task trials, the effect size was relatively small (tracking-only average = 277, tracking-with-side-task average = 242), suggesting that the secondary task was not very demanding. Quite different results might have occurred if the two tasks had required more distinctly different resources or if the secondary task had been substantially more difficult.

Factor Structure of Time-Sharing

The design of the Time-Sharing Task provided several conceptually interesting measures of performance. In order to examine learning rate, the regression slope and intercept were calculated for each subject's average difficulty score for trials 3 through 10. The first two trials were not used because performance on these trials deviated significantly from the linear trend shown on trials 3 through 10 (see Figure 1). Also included were average difficulty scores for trials 11 through 13 (side task 1 - 2 digits), trials 14 through 16 (side task 2 - 8 digits) and trials 17 through 19 (no side task); difference scores for difficulty level with no side task (trials 17 through 19) versus side task 1 (trials 11 through 13) and side task 2 (trials 14 through 16); and average response time to cancel the digits for trials 11 through 13 and trials 14 through 16. These variables were chosen to reflect changes in performance on the tracking task as a function of workload.

As can be seen from the inter-item correlation matrix in Table 4, variables of the same type tended to be related closely but were related less strongly to variables of other types. The slope and intercept were correlated strongly (r = -.734), as were the three average difficulty scores (r between .685 and .727), the two difference scores (r = .891) and the two average response times (r = .455).

A principal components factor analysis yielded four factors. The principal factor included the three average difficulty scores. The two difference scores loaded on Factor 2, whereas the

Table 4. Time-Sharing: Inter-Item Correlation Matrix

Variable[a] (trials)	Slope	Intercept	Avg. Dift (11 - 13)	Avg. Dift (14 - 16)	Avg. Dift (17 - 19)	Diff. Score (11 - 13)	Diff. Score (14 - 16)	Avg. RT (11 - 13)	Avg. RT (14 - 16)
Slope (3 - 10)	1.000								
Intercept (3 - 10)	-.734	1.000							
Avg. Dift (11 - 13)	.094	.394	1.000						
Avg. Dift (14 - 16)	.156	.378	.727	1.000					
Avg. Dift (17 - 19)	.153	.362	.685	.719	1.000				
Diff. Score (11 - 13)	-.024	.003	-.197	.020	.277	1.000			
Diff. Score (14 - 16)	-.047	-.007	-.102	-.193	.306	.891	1.000		
Avg. RT (11 - 13)	-.017	-.093	-.291	-.132	-.130	-.053	-.019	1.000	
Avg. RT (14 - 16)	-.043	-.086	-.143	-.257	-.135	-.016	.069	.455	1.000

[a]These variables labels refer to: Slope; Intercept; Average Difficulty Level for trials 11 through 13, 14 through 16, and 17 through 19; Difference Scores for trials 11 through 13 and 14 through 16; and Average Response Time on the secondary task for trials 11 through 13 and 14 through 16.

slope and intercept loaded on Factor 3, and the two average response times loaded on Factor 4. The eigenvalue for the fourth factor was less than 1.0 after varimax rotation. The four factors accounted for 76% of the total item variance. A summary of the final factor solution is provided in Table 5.

Table 5. Time-Sharing: Summary of Factor Analysis

Variable (trials)	Communality	Factor 1	Factor 2	Factor 3	Factor 4
Slope (3 - 10)	.903	-.194	-.027	.929	-.209
Intercept (3 - 10)	.932	.404	-.009	.875	-.130
Avg. Dift (11 - 13)	.711	.801	.144	.073	-.063
Avg. Dift (14 - 16)	.761	.857	-.093	.020	.033
Avg. Dift (17 - 19)	.870	.876	.313	.010	.003
Diff. Score (11 - 13)	.799	.022	.093	.001	-.024
Diff. Score (14 - 16)	.997	.028	.998	.018	-.065
Avg. RT (11 - 13)	.619	-.090	.003	-.021	.781
Avg. RT (14 - 16)	.331	-.128	.018	-.004	.561

Factor	Eigenvalue	% of Explained Variance	Cumulative %
1	2.61	37.7	37.7
2	1.93	27.8	65.5
3	1.56	22.6	88.1
4	0.82	11.9	100.0

Note. N = 1,130.

The factor analysis results suggest that a model for this Time-Sharing Task should include learning rate on the primary task under single-task conditions (slope and intercept), performance on the primary task (average difficulty level on trials 11 through 19), performance on the secondary task (average response time on the secondary task), and a dual-task interaction term (average difficulty level by average response time on trials 11 through 16).

Inferential Measures

UPT Final Outcome/ATRB Rating. A regression equation that used each subject's slope and intercept for the primary tracking task (trials 3 through 10), average difficulty level (trials 11 through 19), average response time to cancel digits (trials 11 through 16), and average difficulty level by response time interaction (trials 11 through 16) was used to predict flight training performance. This model was not related significantly to either UPT final outcome (multiple R = .184, n.s.) or ATRB rating (multiple R = .254, $p \leq .10$). Subjects who had performed better on the early tracking-only trials (high intercept and low slope) and dual-task trials (high average difficulty score and low average response time on the digit-canceling task) were more likely to be recommended for advanced training in a fast-jet (FAR) aircraft. A summary of these regression analyses is provided in Table 6.

One explanation for these results is that UPT outcome was more likely to be affected by non-performance factors than was the advanced training recommendation. Candidates may have failed UPT for several reasons unrelated to flying performance (medical elimination, academic failure, self-initiated elimination). Because the advanced training decision was not made until late in the UPT program (42nd week), most of these non-performance-related eliminations had already occurred. Therefore, candidates were being evaluated more directly on their ability at that point.

Table 6. Summary of UPT Regression Analyses

				Correlation with Outcome					
Outcome measure	N	Mean	SD	Slope	Intercept	Avg. Dift 11 - 19	Avg. RT 11 - 16	Dift by RT	Mult. R
UPT pass/fail	212	0.80	0.40	-.123	.163	.125	-.056	.055	.186
ATRB TTB/FAR	158	0.59	0.49	-.092	.208	.135	-.069	.044	.254
T-37 midphase grade	46	2.33	1.03	-.247	.252	.093	.234	.230	.313
T-37 contact grade	46	2.89	0.85	-.111	.130	.227	.063	.134	.309
T-37 inst. grade	46	3.15	0.82	-.122	.023	-.019	-.085	-.086	.231
T-38 contact grade	46	2.85	1.12	.007	.026	.153	.140	.171	.205
T-38 inst. grade	46	3.07	0.95	-.237	.066	-.244	.098	-.047	.381
T-38 formation grade	45	3.11	0.91	-.229	.314	.133	.138	.211	.406
T-37 midphase percent	46	82.39	7.18	-.173	.129	.146	.068	.139	.281
T-37 contact percent	46	89.96	5.01	.021	-.010	.001	.014	.001	.067
T-37 inst. percent	46	93.25	4.86	-.074	.058	-.016	-.134	-.088	.201
T-38 contact percent	46	92.77	4.78	-.095	.007	-.086	.082	.036	.213
T-38 inst. percent	46	93.48	4.83	-.278	.170	-.131	.127	.040	.337
T-38 formation percent	45	92.77	5.17	-.284	.370	.075	.085	.138	.440

*$p \leq .05$.

Check Flight Scores. Unfortunately, only 46 of the 212 subjects with UPT final outcome scores also had check flight scores at the time of this analysis. Although the Time-Sharing model demonstrated moderate relationships with several of the check flight grades and percentage scores, none was significant at the .05 level of probability. Of the five variables in the Time-Sharing model, performance on the early tracking-only trials was related most closely to check flight performance. Table 6 provides details of the check flight score regression analyses.

IV. CONCLUSION

The BAT Time-Sharing Task was shown to be very reliable. Although performance on this task was decremented significantly during the dual-task trials, the actual effect of the secondary task was relatively small. This may have been because the secondary task of canceling digits was not sufficiently demanding.

Performance on the Time-Sharing Task was not related significantly to either UPT pass/fail outcome or check flight scores, but was marginally related to ATRB rating. Therefore, this subtest may be most useful when the goal is the initial selection of pilot candidates who are most likely to be recommended for a special advanced training assignment (TTB or FAR; EURO-NATO Joint Jet Pilot Training [ENJJPT] Program; Air National Guard) or the early classification of pilots for specialized training (Specialized Undergraduate Pilot Training [SUPT]).

It should be noted that, in general, performance on the early tracking-only trials was related most closely to UPT performance. These results suggest that the Time-Sharing Task within the BAT could be shortened without adversely affecting its reliability or predictive utility. Also, it may be useful either to use a more demanding side task (e.g., arithmetic problems) or one that requires different resources (e.g., dichotic listening, verbal reasoning).

Future studies should be accomplished when additional UPT outcome data become available (especially check flight scores), in order to cross-validate these results.

REFERENCES

Ackerman, P.L., Schneider, W., & Wickens, C.D. (1984). Deciding the existence of a time-sharing ability: A combined methodological and theoretical approach. Human Factors, 26, 71-82.

Braune, R., & Wickens, C.D. (1985). Time-sharing revisited: Test of a componential model for the assessment of individual differences. Proceedings of the Third Symposium on Aviation Psychology. Columbus, OH: Ohio State University.

Carretta, T.R. (1987). Basic Attributes Tests (BAT) system: Development of an automated test battery for pilot selection (AFHRL-TP-87-9). Brooks AFB, TX: Manpower and Personnel Division, Air Force Human Resources Laboratory.

Damos, D.L. (1978). Residual attention as a predictor of pilot performance. Human Factors, 20, 435-440.

Gabriel, R.F., & Burrows, A.A. (1968). Improving time sharing performance of pilots through training. Human Factors, 10, 33-40.

Gopher, D., & Kahneman, D. (1971). Individual differences in attention and their prediction of flight criterion. Perceptual and Motor Skills, 33, 1335-1342.

National Research Council (1982). Automation in combat aircraft. Washington, DC: Committee on Automation in Combat Aircraft, National Academy of Science.

Roscoe, S.N., & Kraus, E.F. (1973). Pilotage error and residual attention: The evaluation of a performance control system in airborne area navigation. Navigation, 20, 267-279.

Walker, N.K., & Walker, M.M. (1979). Dual-task performance (ZITA/ADT) on ANG and USAF pilots and a comparison with results of cockpit simulator tests and with dive bombing and strafing results. Rockville, MD: M.K. Walker Associates.

Wickens, C.D., & Benel, D.C.R. (1982). The development of time-sharing skills. In J.A.S. Kelson & J.E. Clark (Eds.), The development of movement control and coordination. New York: John Wiley and Sons.